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INSTRUCTION BOOK

FREQUENCY MODULATED SIGNAL GENERATOR TYPE CA-202-B

Maufactured for

UNITED STATES DEPARTMENT OF COMMERCE
CIVIL AERONAUTICS ADMINISTRATION

CONTRACT Cca-29175

Order Nos. CA-51-3738 Dated: April 17, 1951
CA-51-3853 Dated: June 18, 1951

Manufactured by

BOONTON RADIO CORPORATION
Intervale Road, Boonton, New Jersey

NOTE

The 202-B Frequency Modulated Signal Generator referred to within the text is identical electrically and physically with Type CA-202-B and, accordingly, this instruction manual is applicable for use with either instrument type.

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TYPE 202-B FM SIGNAL GENERATOR

1. INTRODUCTION.

a. GENERAL.

The Type 202-B Frequency Modulated Signal Generator has been specifically designed for use in the development and testing of frequency modulated receivers and television FM sound channel equipment within the frequency range of from 54 to 216 megacycles. Provisions have also been made whereby it may be used in this frequency range as an amplitude modulated r-f signal source or, in conjunction with an external audio oscillator, may be used to produce simultaneous FM and AM r-f signals.

Physically this instrument consists of four major subassemblies: (1) panel assembly, (2) r-f assembly, (3) audio oscillator, and (4) regulated power supply.

The r-f unit is secured to the rear of the front panel while the audio oscillator and power supply are fastened to the bottom of the generator cabinet and are electrically connected to the front panel and r-f assembly by means of cables and plug connectors.

The wiring and layout of the various components have been arranged for maximum simplicity resulting in a compact instrument of moderate size, thereby conserving laboratory space. All meters and calibrated controls are direct reading and are located on the front panel according to function. The frequency dial, as well as the modulation and output meters, has been positioned at eye-level for maximum readability. Exclusive use of aluminum for cabinet, panel, and chassis fabrication has resulted in a relatively lightweight, easily portable instrument. For convenience in carrying a collapsible leather handle is attached to the top of the generator cabinet. This instrument is supplied complete with tubes, instruction book, and r-f cable type number 501-A.

b. BASIC OPERATING PRINCIPLES (Fig. 1).

Figure 1 shows in block form the basic elements employed in the 202-B Signal Generator. A type 6C4 triode is used as an r-f oscillator and is tuned over the frequency range of 27-54 megacycles.

Coupled to the r-f oscillator is a 6AK5 reactance tube, which, for frequency modulation, shifts the frequency of the oscillator in direct proportion to the instantaneous audio voltage applied to the reactance tube from the audio modulating oscillator.

The output from the r-f oscillator is fed to a Class C frequency doubling stage which is tuned to the second

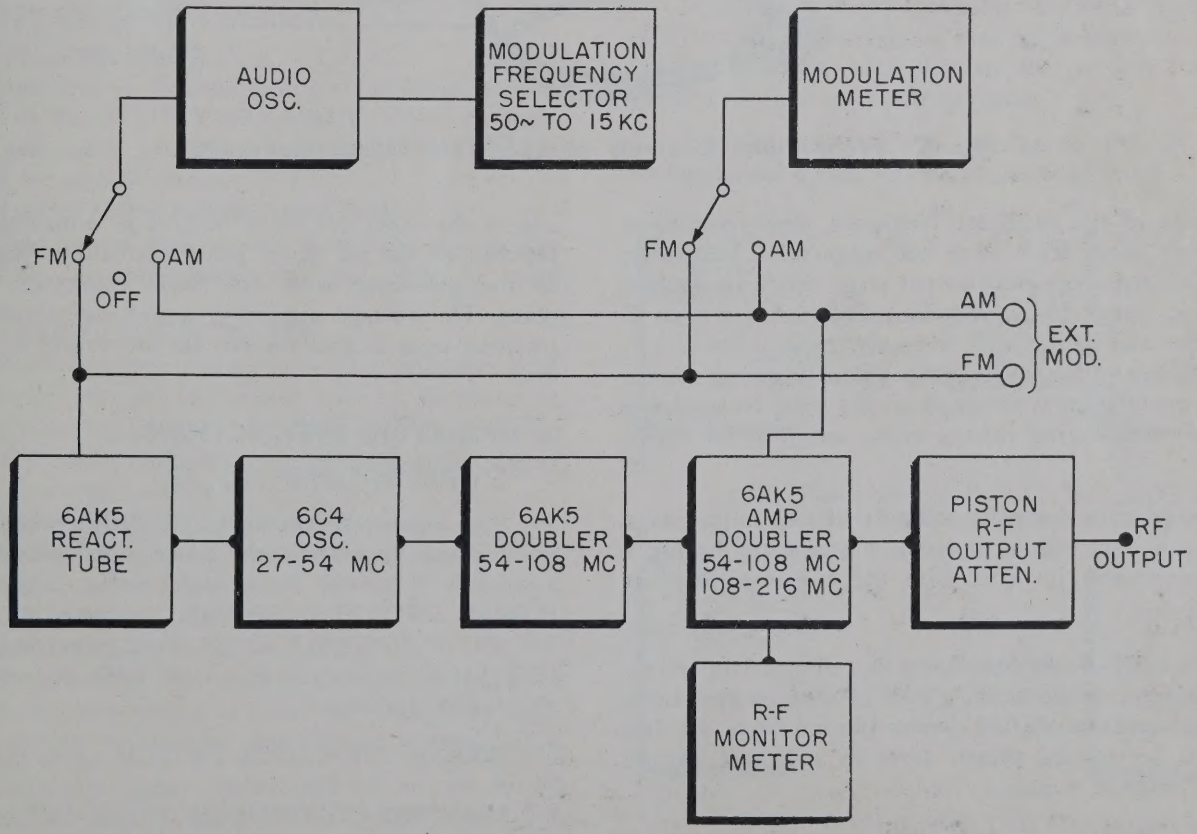


Fig. 1. Basic Elements of 202-B FM Signal Generator

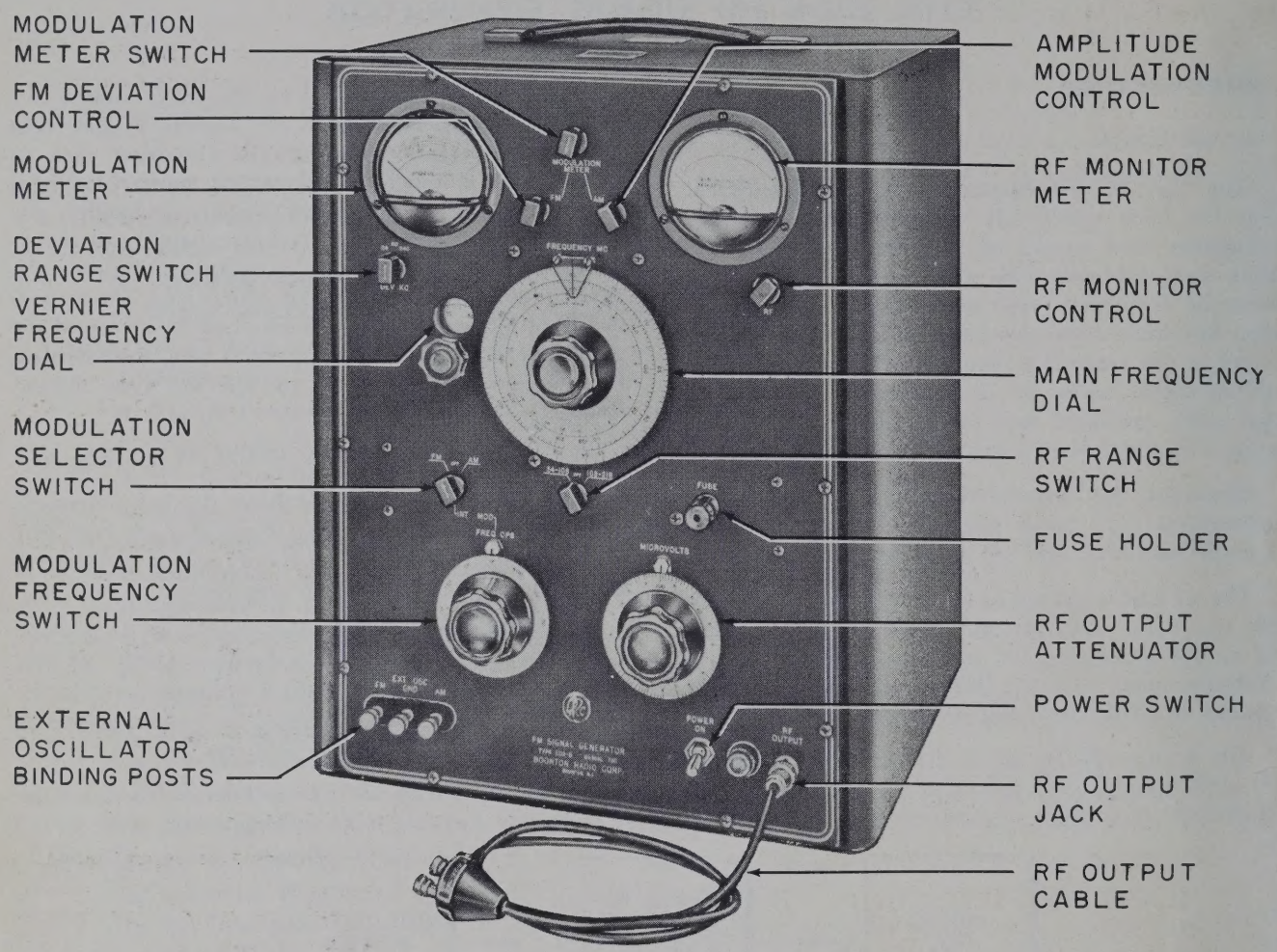


Fig. 2. Front Panel Controls of 202-B FM Signal Generator

harmonic of the oscillator frequency, thus covering a frequency range from 54 to 108 megacycles. Following this doubling stage is an output stage which in the low frequency range (54 to 108 mc.) operates as a Class C amplifier and in the high frequency range (108 to 216 mc.) becomes a Class C frequency doubling stage. Amplitude modulation is obtained at this stage by applying an audio modulating voltage to the screen of the 6AK5 tube.

Coupled to the plate inductor of the output stage is a piston type mutual inductance attenuator having a 53 ohm resistor in series with the one turn coupling loop.

The dial of the attenuator is calibrated in microvolts in terms of the voltage present at the output cable terminal posts when the power output from the last stage is set to the proper level as indicated by the output monitor meter.

The 53 ohm r-f output cable is terminated at one end by a 53 ohm resistor and terminal post assembly, and at the other end by a BNC type connector which attaches to the r-f panel jack. The output impedance of the generator with this cable connected is 26.5 ohms. The voltage appearing across the output cable terminal posts is read directly on the output attenuator dial.

2. OPERATING INSTRUCTIONS.

a. PRELIMINARY (Fig. 2).

The instrument should be carefully removed from the packing carton and the power cord plugged into a suitable 115 volt, 50-60 cycle outlet. Operate the POWER SWITCH to the "ON" position. Attach the R-F OUTPUT CABLE to the front panel R-F OUTPUT JACK by pushing in on the cable connector and rotating it clockwise.

With the R-F RANGE SWITCH set to either the 54-108 mc. or the 108-216 mc. range, operation of the R-F MONITOR CONTROL should cause the pointer of the R-F MONITOR METER to move. It should be possible to set the meter pointer to the red reference mark

over the entire frequency range from 54-216 mc. This is an indication that the r-f oscillator and amplifier are working properly.

To check the FM and AM modulating systems, turn the MODULATION SELECTOR SWITCH to FM, the MODULATION METER SWITCH to FM, and the DEVIATION RANGE SWITCH to 24 kc., 80 kc., or 240 kc. Operating the FM DEVIATION CONTROL in a clockwise direction should cause the MODULATION METER to read increasing deviation. Switch the MODULATION SELECTOR SWITCH to AM, the MODULATION METER SWITCH to AM, and rotate the AMPLITUDE MODULATION CONTROL clockwise. The MODULATION METER should read the degree of amplitude modulation present and full-scale setting should be possible.

b. OPERATING CONTROLS (Fig. 2).

This section describes the operating controls which are located on the front panel of the instrument starting with those at the lower left hand part of the panel and proceeding clockwise around the face of the instrument.

1. MODULATION FREQUENCY SWITCH.

This control selects any one of eight fixed audio frequencies between 50 cycles and 15 kilocycles for either frequency or amplitude modulation.

2. MODULATION SELECTOR SWITCH.

Either frequency or amplitude modulation may be obtained by setting this switch to the proper position. Modulation may also be turned off.

3. VERNIER FREQUENCY DIAL.

This dial is divided into 100 divisions and is coupled to the MAIN FREQUENCY DIAL through a 24:1 gear train, providing a total of 2400 logging divisions for each r-f range.

4. DEVIATION RANGE SWITCH.

This rotary type switch selects three modulation meter deviation ranges, 0-24 kc., 0-80 kc., and 0-240 kc.

5. MODULATION METER.

Four modulation meter scales are provided, 0-24 kc. deviation in 1 kc. increments, 0-80 kc. deviation in 5 kc. increments, 0-240 kc. deviation in 10 kc. increments, and 0-50% amplitude modulation, with calibration marks at 30% and 50%.

6. FM DEVIATION CONTROL.

A continuously variable control for adjusting the frequency deviation on any of the three ranges 0-24 kc., 0-80 kc., or 0-240 kc.

7. MODULATION METER SWITCH.

By means of this control the MODULATION METER may be switched to either the FM or AM modulating system to indicate the degree of modulation present.

8. AMPLITUDE MODULATION CONTROL.

A continuously variable control for adjusting the amplitude modulation level.

9. R-F MONITOR METER.

The R-F MONITOR METER is used to standardize the power level of the last r-f amplifier stage. In operation the meter pointer is set to the red calibration line on the meter scale.

10. R-F MONITOR CONTROL.

This adjustment sets the R-F MONITOR METER to the proper reference level such that the output attenuator calibration is direct reading in microvolts.

11. MAIN FREQUENCY DIAL.

The MAIN FREQUENCY DIAL has two frequency calibrations, 54-108 megacycles and 108-216 megacycles. An inner scale is divided into 24 equal divisions for use with the VERNIER FREQUENCY DIAL.

12. R-F RANGE SWITCH.

This control selects either the low frequency range, 54-108 megacycles, the high frequency range, 108-216 megacycles, or turns the r-f carrier off.

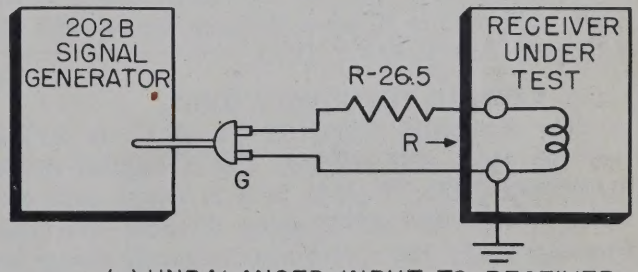
13. R-F OUTPUT ATTENUATOR.

The R-F OUTPUT ATTENUATOR DIAL is calibrated directly in microvolts output at the output cable terminals. It is standardized by setting the pointer of the R-F MONITOR METER to the red calibration mark on the meter scale.

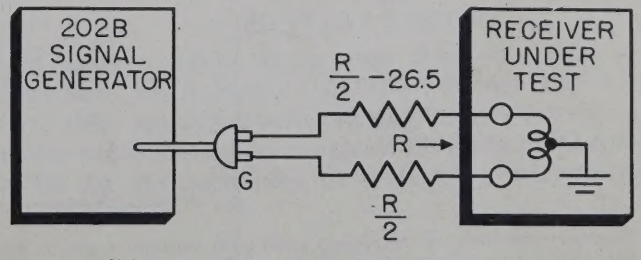
c. OUTPUT CONNECTIONS.

In order to match properly the input impedance of a receiver under test, it may be desirable to add a resistor in one or both sides of the r-f line from the signal generator as shown in figure 3 .

For the case of the unbalanced receiver input an impedance match may be obtained by connecting the



(a) UNBALANCED INPUT TO RECEIVER
R=INPUT IMPEDANCE TO RECEIVER



(b) BALANCED INPUT TO RECEIVER

Fig. 3. Receiver Connections

proper resistance to the "high" signal generator terminal and connecting the ground of the signal generator to the receiver ground (figure 3a).

To use the signal generator with a receiver having a balanced input impedance, connections should be made according to figure 3b. As a check for the possibility of the ground between generator and receiver being low enough to shunt the padding resistor in the low side of the r-f line, the power plug of the generator may be moved to a different, outlet. Negligible change in readings should be observed.* Resistors independent of frequency should be used to avoid errors due to reactance.

d. SIMULTANEOUS FM AND AM.

For certain tests simultaneous FM and AM is sometimes desired. The 202-B FM Signal Generator, in combination with an external low distortion audio oscillator, may be used for this purpose provided that the audio oscillator is capable of developing approximately 5 volts across a 1500 ohm load, the FM requirement for 240 kc. deviation.

In use the external audio oscillator is connected to the FM external binding posts, the MODULATION SELECTOR SWITCH set to AM, and the levels of each type of modulation independently set on the MODULATION METER by operation of the MODULATION METER SWITCH, FM DEVIATION CONTROL, and AMPLITUDE MODULATION CONTROL.

CAUTION:

Use of an external audio oscillator for AM, with the INTERNAL MODULATION OSCILLATOR switched to FM, will result in interaction between modulation circuits when both oscillators are operating at or near the same audio frequency.

3. SPECIFICATIONS.

a. R-F RANGE.

Overall frequency coverage 54 to 216 megacycles in two ranges: 54-108 megacycles and 108-216 megacycles, accurate to within $\pm 0.5\%$ after a warm-up period of one hour. The MAIN FREQUENCY DIAL is also calibrated in 24 equal divisions for use with the VERNIER FREQUENCY DIAL.

b. VERNIER FREQUENCY DIAL.

The VERNIER FREQUENCY DIAL is divided into 100 equal scale divisions and is coupled to the MAIN FREQUENCY DIAL by a 24:1 gear train, providing a total of 2400 logging divisions over each frequency range. The approximate frequency change per vernier division is 26 kc on the low range and 52 kc on the high range.

c. R-F OUTPUT VOLTAGE.

The maximum open circuit output voltage from the BNC type R-F OUTPUT JACK at the front panel is about 0.4 volt. With the standard output cable (type 501-A) attached, the maximum calibrated output voltage at the cable terminals is 0.2 volt. When the R-F MONITOR METER is set to the red calibration line and the standard output cable attached, the R-F OUTPUT ATTENUATOR is direct reading in microvolts and continuously adjustable from 0.1 microvolt to 0.2 volt. Accuracy is approximately $\pm 10\%$

d. R-F OUTPUT IMPEDANCES.

The r-f output impedance of the signal generator as seen looking in at the BNC type front panel connector is 53 ohms resistive. With the standard output cable attached, the r-f output impedance as seen looking in at the output cable terminals is 26.5 ohms resistive.

e. FREQUENCY MODULATION.

Three frequency deviation ranges 0-24 kc., 0-80 kc., and 0-240 kc. are provided, each continuously adjustable. The 0-24 kc. deviation scale is calibrated in increments of 1 kc., the 0-80 kc. scale in increments of 5 kc., and the 0-240 kc. scale in increments of 10 kc.

f. AMPLITUDE MODULATION.

Amplitude modulation is available over the range from 0-50%, with meter calibration points provided at 30% and 50% modulation.

g. DISTORTION.

1. FM. The overall FM distortion at 75 kc. is less than 2% and at 240 kc. less than 10%.

2. AM. The distortion present at the RF output for 30% amplitude modulation is less than 3% and for 50% AM less than 6.5%.

h. SPURIOUS R-F OUTPUT.

All spurious r-f output voltages are at least 30db below the desired fundamental. Total RMS spurious FM from the 60 cycle power source is down more than 50 db, with 75 kc. deviation as a reference level.

i. FIDELITY CHARACTERISTICS.

The deviation sensitivity of the FM modulation system as a function of frequency is constant from dc. to better than 10 kc. At 15 kc. the deviation as indicated on the modulation meter is 0.5 db higher than the true value. The amplitude modulation system is also flat to 10 kc. and is down 1.0 db at 15 kilocycles.

j. INTERNAL AF OSCILLATOR.

The internal audio oscillator may be switched to provide either frequency or amplitude modulation; it may also be switched off. External binding posts permit the use of an external AF oscillator for either FM or AM. The internal oscillator and an external low distortion AF oscillator may be used simultaneously to produce a signal which is frequency modulated at two different audio frequencies. With the internal oscillator switched for AM, an external AF oscillator may be used simultaneously to frequency modulate the AM signal.

The internal AF oscillator provides eight fixed frequencies which may be selected by a rotary type switch - 50, 100, 400, cycles, and 1, 5, 7.5, 10, 15 kilocycles, accurate to within 5%. Harmonic distortion, in general, is less than 0.5%.

The output voltage of the internal oscillator is available at the external binding posts for synchronizing or other purposes.

**Various methods of obtaining push pull voltage from an unbalanced generator output are discussed in the RCA Review, Vol. VI, April 1942, Number 4, in an article entitled "Receiver Input Connections for U-H-F- Measurement" by John A. Rankin.*

k. EXTERNAL MODULATION REQUIREMENTS.

1. Frequency Modulation.

The frequency deviation sensitivity is 50 kc. per volt on the 0-240 kc. deviation range and 16.6 kc. per volt on the 0-80 kc. deviation range. For external FM the input impedance is 1500 ohms maximum.

2. Amplitude Modulation.

Approximately 45 volts is required for 50% modulation on either the high or low r-f range. For external AM the maximum input impedance is 7500 ohms shunted with 1000 mmf.

3. Audio Voltage for External Use.

There is available at the FM external oscillator binding posts about 5 volts ac maximum and at the AM external oscillator binding posts, 50 volts maximum.

l. TUBE COMPLEMENT.

Audio Oscillator	6J5, 6V6GT/G	(V1, V2)
Rectifier	5Y3GT/G	(V3)
Voltage Regulator	VR-150	(V4)
Reactance Modulator	6AK5	(V5)
R-f Oscillator	6C4	(V6)
Doubler Stage	6AK5	(V7)
Doubler and Output	6AK5	(V8)
Ballast Resistor	6H-6	(R18)

m. POWER REQUIREMENTS

The 202-B FM Signal Generator is designed for use with 115 volts, 50-60 cycles. It will operate satisfactorily, however, over a voltage range from 105-125 volts without changing the r-f frequency by more than 0.05%. A two ampere fuse is placed in one side of the a.c. line for protective purposes. Power consumption is 65 watts.

n. DIMENSIONS AND WEIGHT.

Outside cabinet dimensions: 17" H, 13½" W, 11½" D.

Weight: 35 pounds.

o. ACCESSORIES.

Available as an accessory is the 203-B Univerter which, in combination with the 202-B F.M. Signal Generator, provides additional frequency coverage from 0.4 mc. to 25 mc. at unity gain. The 203-B Univerter consists of a local 70 mc. oscillator, mixer stage, and broad band amplifier. The frequency of the local oscillator is factory adjusted and may be checked by obtaining zero-beat with the 202-B output at 70 mc. The output frequency of the 203-B Univerter is determined by subtracting 70 mc. from the 202-B Signal Generator MAIN FREQUENCY DIAL reading.

In use the input cable of the 203-B unit is attached to the R-F OUTPUT JACK of the 202-B Signal Generator and the type 501-A R-F Output Cable is transferred to the output jack of the 203-B Univerter. Since the Univerter has unity gain, its output level is indicated directly by the R-F ATTENUATOR setting of the 202-B instrument. The output impedance of the 203-B Univerter is approximately 26.5 ohms with output cable attached.

4. THEORY OF OPERATION.*

a. REACTANCE MODULATOR CIRCUIT (Fig. 4).

A 6AK5 tube (V5) operating as an inductive element across the tank circuit of the 6C4 (V6) oscillator circuit is employed for reactance modulation. In order to maintain constant frequency deviation sensitivity over

**Theory of operation and design information are given in an article in the November, 1946 issue of Electronics Magazine entitled "Design of F-M Signal Generator" by Donald M. Hill and Murray G. Crosby.*

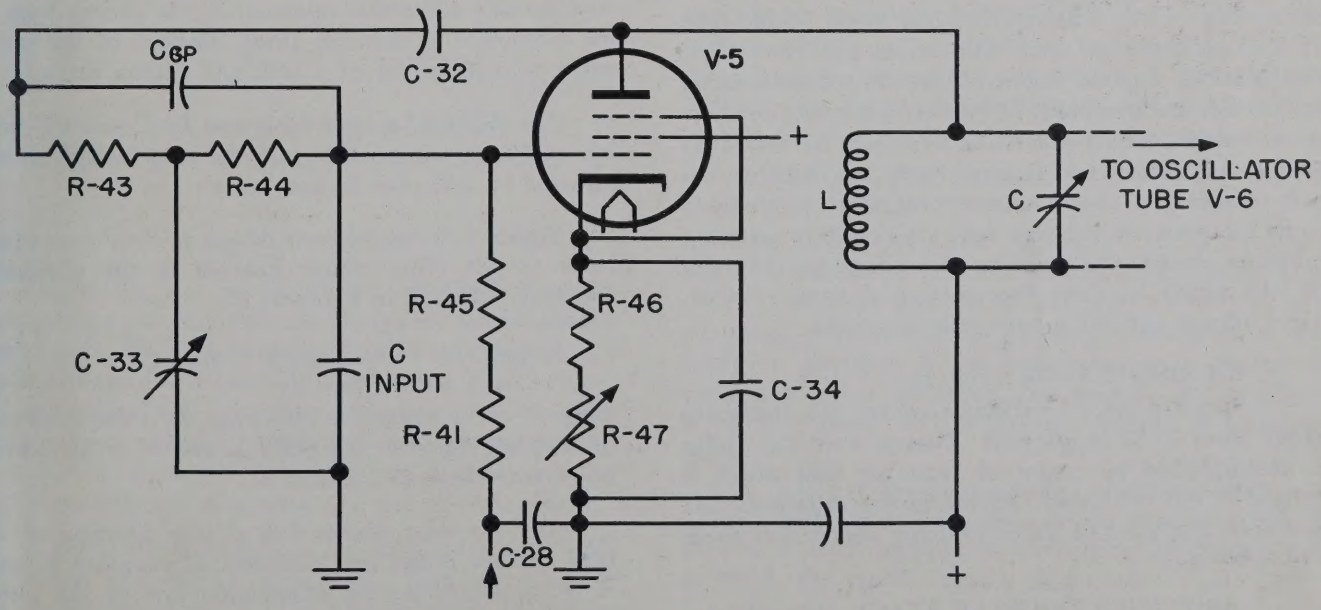


Fig. 4. Basic Reactance Modulator Circuit

the entire tuning range of the instrument the amount of inductance injected by V5 is made to vary directly as the carrier frequency. This is accomplished (fig. 4) by a bridged tee network consisting of R43, R44, C33, the grid plate capacitance of V5, and the grid cathode capacitance of V5. Although this circuit arrangement is capable of producing fairly constant deviation with fixed components, C33 is made variable and ganged with the oscillator tuning condenser to provide the precision of deviation calibration required in a signal generator.

Resistor R50 serves to bleed the proper amount of current through R46, R47 to permit operation of V5 over the most linear portion of its characteristics (fig. 8).

The cathode resistors R46 and R47 which provide bias for V5 are bypassed by C34 for radio frequencies only and degeneration takes place at audio frequencies. Resistor R47 is used to adjust the amount of degeneration present in order to provide the desired deviation sensitivity.

On the high r-f range the modulation voltage for FM is reduced to one half in order to maintain the same frequency deviation (fig. 8). This is accomplished by means of resistors R23, R26, and switch S5 (fig. 8) which is mechanically coupled to the r-f range changing switch. Switch S3 reduces the modulating voltage applied at the reactance tube to one third when operated from the 0-240 kc. deviation position to the 0-80 kc. devaition position, and to one tenth when operated from the 0-240 kc. deviation position to the 0-24 kc. deviation position.

For FM, an audio modulating voltage is applied directly to the grid of V5, the reactance tube, through an r-f filter which prevents stray r-f currents from leaking out of the shielded portion of the instrument.

b. AF OSCILLATOR (Fig. 8).

The AF oscillator employed is quite free from distortion having, in general, total harmonic content of less than 0.5%. The conventional Wein bridge type of R-C oscillator is used. The series and shunt R-C combinations required to provide the desired modulating frequencies are mounted directly on the rotary type selector switch and are connected by means of two leads to the AF chassis which mounts the oscillator tubes and components. Approximately 50 volts is obtained from the plate of the 6V6 tube (V2) for modulating purposes, the exact value being controlled by adjustment of R12 which regulates the amount of negative feedback voltage applied to the cathode of V1.

c. R-F OSCILLATOR (Fig. 8).

A tuned plate r-f oscillator covers the frequency range from 27-54 megacycles. Tuning over this range is accomplished by means of capacitor C39 which is ganged to the two other variable tuning capacitors C45 and C50. The plate of V6 is normally operated at about 150 volts d-c.

d. AMPLIFIER DOUBLER STAGE (Fig. 8).

A frequency doubling stage (V7) follows the oscillator, and serves the two fold purpose of (1) permitting the oscillator to be operated at a lower frequency and (2) providing the desired isolation between oscillator and output stage to improve freqency stability. A further advantage is that it provides sufficient drive to saturate the output stage and thus remove any spurious amplitude modulation up to this point. This stage is self-biased and is arranged to track with the oscillator.

e. OUTPUT STAGE (Fig. 8).

The output stage employs a 6AK5 tube operating in Class C. For the low r-f range, this stage functions as an amplifier, and over the high range becomes a frequency doubler. The output tank coil is provided with two contact points located so that when the ground contact is switched from the lower to the upper point, the inductance of the tank coil is changed to double the resonant frequency of the tank circuit. Switching is accomplished by two spring contact fingers, one or the other of which is pressed against a contact point by insulated members on the shaft of the R-F RANGE SWITCH. This method avoids most of the mechanical and electrical difficulties usually associated with coil switching. The Q of the tank circuit has been selected to reduce spurious signals by more than 35 db and at the same time keep amplitude modulation to about 2% at 75 kc. deviation.

Amplitude modulation is obtained by modulating the screen element of V8, sufficient isolation from the dc supply having been provided by the 50 henry choke, L2.

f. OUTPUT ATTENUATOR.

A piston type r-f output attenuator having an internal impedance of 53 ohms is inductively coupled to the tank circuit inductor of the final stage. To provide continuously adjustable attenuation, the pickup loop of the attenuator is movable along the axis of the attenuator tube by means of a rack and pinion drive.

The RG58/U output cable and BNC panel fittings are of 53 ohm impedance and the output cable is terminated by a 53 ohm carbon resistor.

Figure 5 shows the basic design of the output attenuator system. The voltage induced in the attenuator coupling loop L20 in figure 5a is:

$$e' = I\omega M = \frac{E}{\omega L_{19}} \times \omega K \sqrt{L_{19} L_{20}} = EK\sqrt{\frac{L_{20}}{L_{19}}}$$

where $\omega = 2\pi$ times the frequency, K is the coefficient of coupling between L_{19} and L_{20}, and M is the mutual inductance between L_{19} and L_{20}.

This equation shows that e' is a function of the tank voltage E and the coefficient of coupling K only. K is controlled by the attenuation law of the piston attenuator while E is monitored by the output monitor meter.

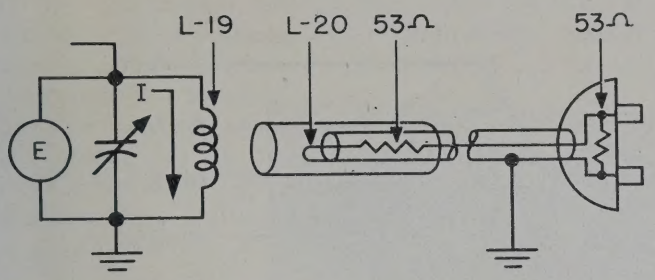


FIG. 5a

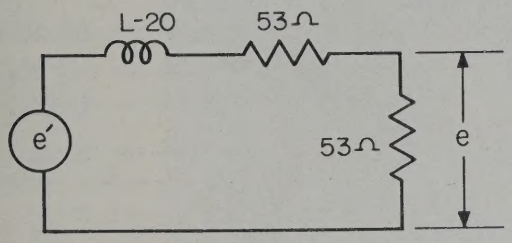


FIG. 5b

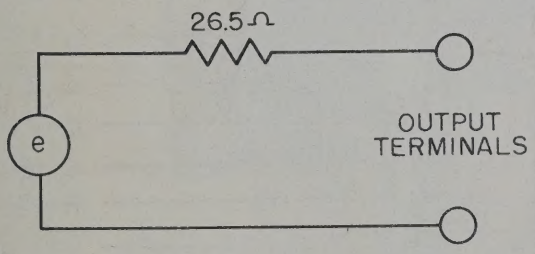


FIG. 5c

Fig. 5. Output Attenuator Equivalent Circuit

It can be seen from figure 5b that the voltage e across the terminating resistor is:

$$e = \frac{53e'}{106 + j\,(\omega L_{20})} = \frac{53e'}{\sqrt{(106)^2 + (\omega L_{20})^2}}$$

Since L_{20} is less than 0.01 microhenry, $(\omega L_{20})^2$ can be neglected in comparison with $(106)^2$ and:

$$e = \frac{e'}{2}$$

Neglecting L_{20} in figure 5b, an application of Thevenin's theorem yields the equivalent circuit shown in figure 5c. Thus the generator can be represented as a source voltage e in series with a resistance of 26.5 ohms. The attenuator dial is calibrated in terms of the open circuit output voltage e (Fig. 5c) and is direct reading in microvolts from 0.1 microvolt to 0.2 volt when the output monitor meter is set to the red reference line.

If the load impedance is not large compared with 26.5 ohms, the voltage applied to a load connected at the output terminals can be calculated by using the equivalent circuit of figure 5c.

5. MAINTENANCE INSTRUCTIONS.

a. R-F UNIT (Fig. 6).

This unit has been carefully adjusted and calibrated at the factory to meet the specifications listed in this instruction book. Specialized testing equipment and procedures are required which make field adjustments and replacements in the unit difficult and undesirable. For this reason the copper shield has been sealed against removal. Since the instrument is guaranteed for workmanship, materials, and performance, instructions for its return to the factory should be immediately obtained if it is found to be unsatisfactory in operation. THIS GUARANTEE, HOWEVER, IS ONLY VALID PROVIDED THE SEAL ON THE R.F. SHIELD IS UNBROKEN.

The 60 cycle heater voltage between pin 5 of plug 2 and ground (fig. 6) should measure 6.3 volts. If the r-f unit is found to be inoperable and this voltage measures in excess of 7 volts, the trouble is probably due to an open heater circuit at one of the r-f tubes. Continued operation of the instrument under this condition will damage the other r-f tubes.

b. VR-150 REGULATOR TUBE (Fig. 7).

When replacing this tube (V4) it is desirable to check its current drain by placing a milliammeter in series with the plate and adjusting R19 for a 7 milliampere plate current with the input voltage to the power transformer primary set at 105 volts. The adjustment will insure proper operation of the power supply over a line voltage range of 105-125 volts.

c. AMPLITUDE MODULATION ADJUSTMENT.

If desired, the degree of amplitude modulation on the modulation meter can be checked by suitably mixing the output of the generator with another signal source such that a difference frequency of approximately 100-150 kc. is produced. This difference frequency can be seen visually on a cathode ray oscilloscope and used for adjustment purposes. Adjustment of R35 (fig. 6) will change the modulation meter AM sensitivity to agree with that degree of modulation present.

d. FREQUENCY MODULATION ADJUSTMENT.

The 6AK5 reactance modulator tube contained within the sealed r-f unit has been carefully adjusted for a deviation sensitivity of 50 kc. per volt on the low r-f range, with the deviation range switch set at the 0-240 kc. position. If for any reason it is desired to check the carrier deviation, this may be accomplished using the Crosby* or carrier zero method of measurement.

A selective communications superheterodyne receiver tuned to the r-f output of the generator can be used as a null indicator to determine the exact point at which the carrier current disappears.

**Crosby, M.G., RCA Rev. Vol. 4, Page 349, 1940*

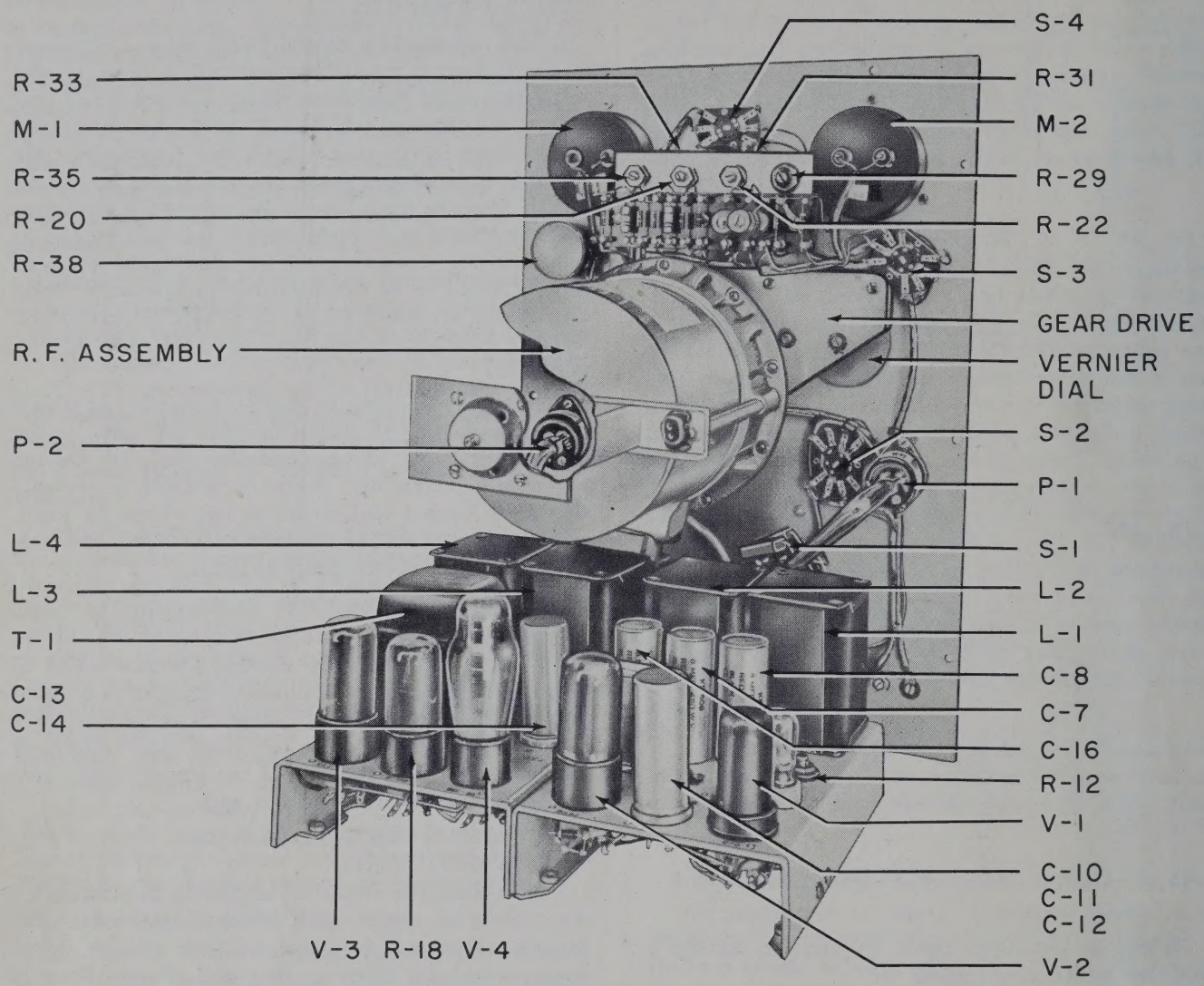


Fig. 6. Rear View of Panel Assembly, Power Supply, and Audio Oscillator

Since the modulation index B is defined as the ratio of the frequency deviation ΔF to the modulating frequency f, or

$$B = \frac{\Delta F}{f}$$

the frequency deviation is given by:

$$\Delta F = B \times f$$

The carrier will reach its minimum value at the following modulation indices:

2.404; 5.5201; 8.653; 11.791; 14.930; 18.071; 21.2116, etc.

The FM deviation indicated on the modulation meter is controlled by the setting of R29 (fig. 6). A slight adjustment of this control may be made if desired, however the actual deviation sensitivity of the reactance modulator is adjusted by means of R47 (fig. 8) within the r-f shield, and should not be disturbed.

NOTE: No r-f output will be obtained with the audio oscillator plug P_1 detached from the front panel assembly since the d-c screen supply for the final amplifier doubler tube, V8, is wired from the power supply through the audio unit and thence to the r-f panel.

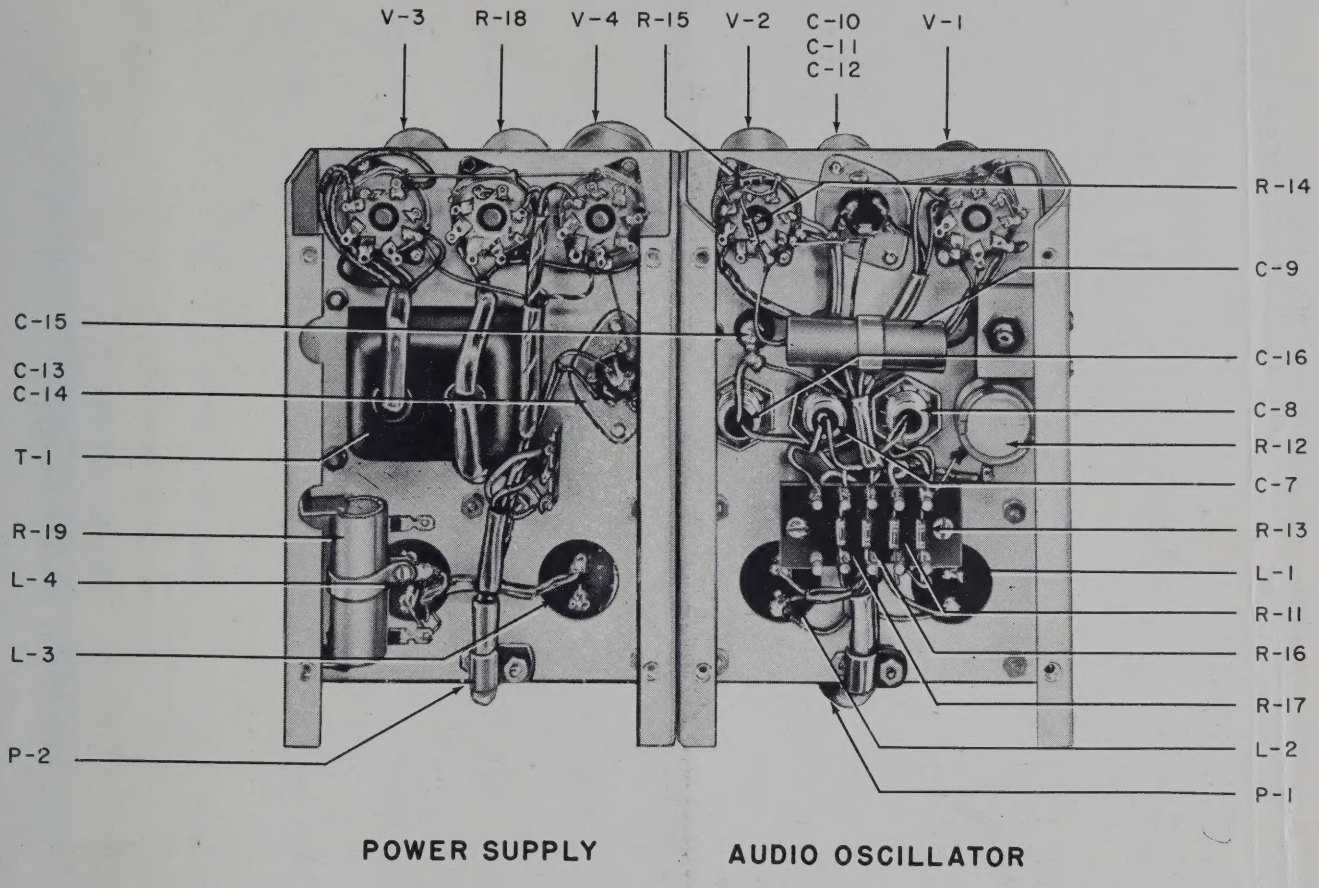
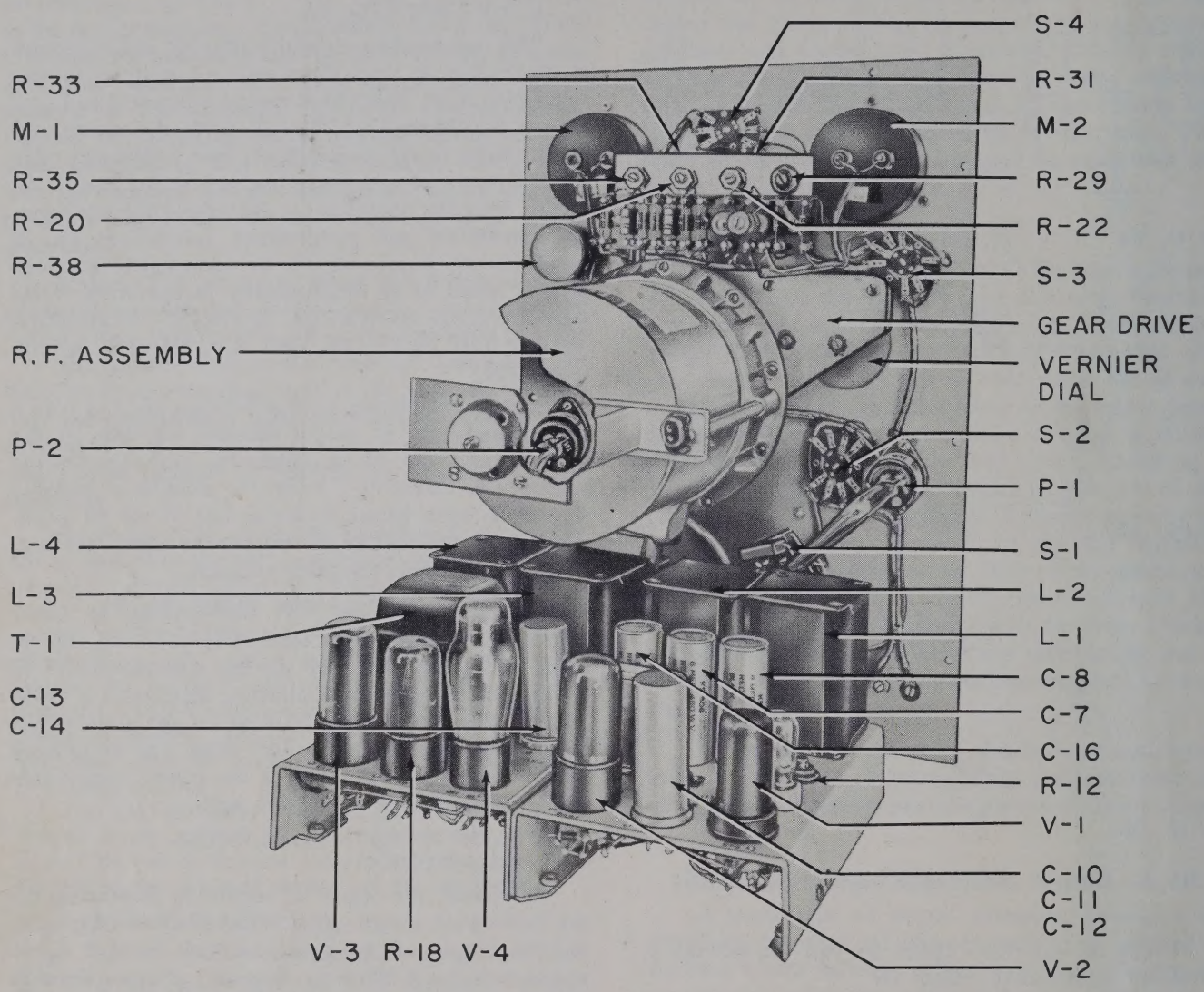


Fig. 7. Sub-chassis View of Power Supply and Audio Oscillator



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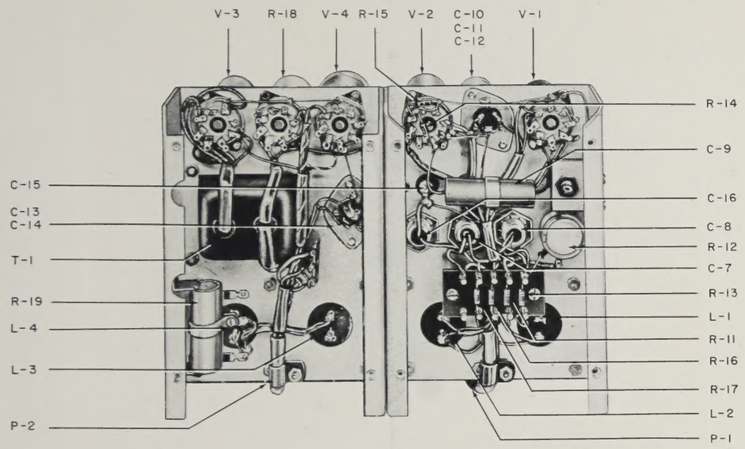

Fig. 7. Sub-chassis View of Power Supply and Audio Oscillator

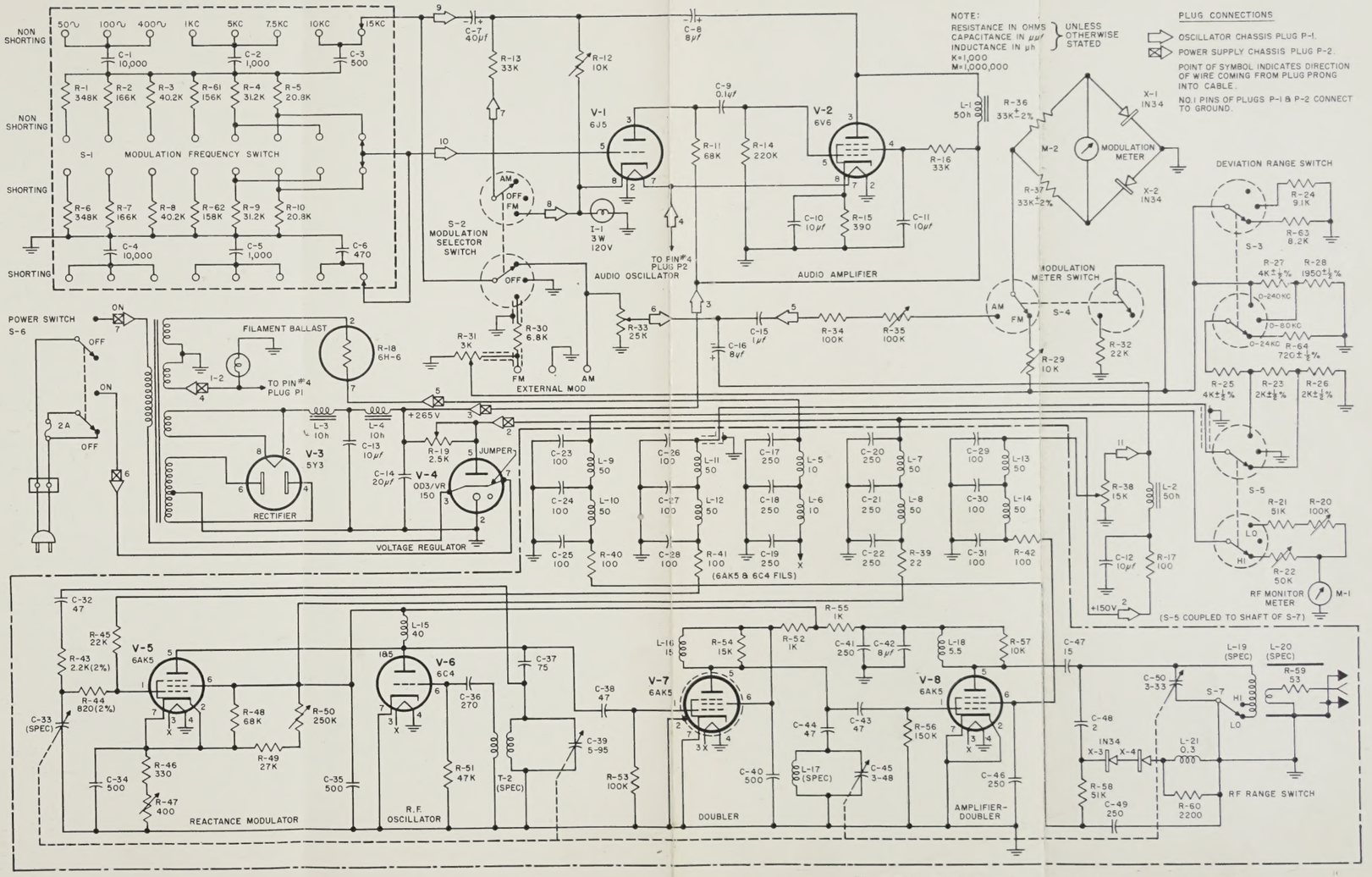

Fig. 8. Schematic Wiring Diagram of 202-B FM Signal Generator

MAINTENANCE PARTS LIST FOR FREQUENCY MODULATED SIGNAL GENERATOR - TYPE CA-202-B

Reference Symbol	Boonraco No.	Description	Manufacturer	Manufacturer's Designation
C-1,4	82414	CAPACITOR, 10,000 uuf, ±2%, 300 V, mica.	Electro-Motive Mfg. Co.	JAN CM40A103G
C-2,5	82302	CAPACITOR, 1000 uuf, ±2%, 500 V, mica.	Electro-Motive Mfg. Co.	JAN CM30C102G
C-3	82234	CAPACITOR, 500 uuf, ±2%, 500 V, mica.	Micamold Products Corp.	CM-20
C-6	82239	CAPACITOR, 470 uuf, ±2%, 500 V, mica.	Micamold Products Corp.	CM-20
C-7,54	83045	CAPACITOR, 40 uf, 150 V, electrolytic.	Aerovox Corp.	PRS-EP
C-8,16	83028	CAPACITOR, 8 uf, 450 V, electrolytic.	Aerovox Corp.	PRS-EP
C-9	83070	CAPACITOR, 0.1 uf, +20%, -10%, 400 V, electrolytic.	Aerovox Corp.	489
C-10,11,12-13,14	83050	CAPACITOR, 10-10-10 uf, 400 V, electrolytic.	P.R. Mallory Co., Inc.	FP-389
C-15	83066	CAPACITOR, 1 uf, +20%, -10%, 400 V, electrolytic.	Aerovox Corp.	418-CB
I-1	90907	LAMP, Incandescent, 120 V, 3W	General Electric Co.	3S6/5
I-2	90904	LAMP, Incandescent, 6.3 V, 0.15a.	General Electric Co.	47
L-1,2	85433	CHOKE, Filter, 50 h.	Freed Transformer Co.,Inc.	13134
L-3,4	85535	CHOKE, Filter, 10 h.	Freed Transformer Co.,Inc.	13195

Reference Symbol	Boonraco No.	Description	Manufacturer	Manufacturer's Designation
M-1	92026	METER, 100 ua, special scale	Marion Electrical Inst. Co.	HM3
M-2	92025	METER, 100 ua, special scale	Marion Electrical Inst. Co.	HM3
R-1,6	80630	RESISTOR, 332K ohms, ±1%, 1/2W	Wilkor Products, Inc.	CP-1/2
R-2,7	80567	RESISTOR, 166K ohms, ±1%, 1/2W	Wilkor Products, Inc.	CP-1/2
R-3,8	80492	RESISTOR, 40.2K ohms, ±1%, 1/2W	Wilkor Products, Inc.	CP-1/2
R-4,9	80491	RESISTOR, 31.2K ohms, ±1%, 1/2W	Wilkor Products, Inc.	CP-1/2
R-5,10	80490	RESISTOR, 20.8K ohms, ±1%, 1/2W	Wilkor Products, Inc.	CP-1/2
R-11,21,34	80517	RESISTOR, 100K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-12,29	81314	POTENTIOMETER, 10K ohms, ±10%, 2W	Allen Bradley Co.	J
R-13,16	80461	RESISTOR, 33K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-14	80555	RESISTOR, 220K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-15	80098	RESISTOR, 150 ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-17	80062	RESISTOR, 100 ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-18	91019	RESISTOR, Thermal, glass.	Amperite Co., Inc.	6H-6
R-19	80268	RESISTOR, Adjustable, 2.5K ohms, ±5%, 25W	Wirt Co.	AR-7
R-23,26	80283	RESISTOR, 2K ohms, ±1/2% 1/2W	Instrument Resistor Corp.	RL

Reference Symbol	Boonraco No.	Description	Manufacturer	Manufacturer's Designation
R-24	80327	RESISTOR, 9.1K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-25,27	80266	RESISTOR, 4K ohms, ±1/2%, 1/2W	Instrument Resistor Corp.	RL
R-28	80207	RESISTOR, 1950 ohms, ±1/2%, 1/2W	Instrument Resistor Corp.	RL
R-30	80387	RESISTOR, 6.8K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-31	81210	POTENTIOMETER, 3K ohms, ±5%, 3W	Centralab	V-133
R-32	80472	RESISTOR, 22K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-33	81411	POTENTIOMETER, 25K ohms, ±10% 3W	Centralab	AF-115
R-35	81507	POTENTIOMETER, 100K ohms, ±10%, 2W	Allen-Bradley Co.	J
R-36,37	80486	RESISTOR, 33K ohms, ±2%, 1/2W	Boonton Radio Corp.	80486
R-38	81331	POTENTIOMETER, 15K ohms, ±5%, 3W	Wirt Co.	GCB
R-61,62	80566	RESISTOR, 156K ohms, ±1%, 1/2W	Wilkor Products, Inc.	CP-1/2
R-63	80326	RESISTOR, 8.2K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
R-93	80640	RESISTOR, 470K ohms, ±5%, 1/2W	Allen-Bradley Co.	EB
S-1	88058	SWITCH, Rotary, 4 pole, 8 position, 4 section	Oak Mfg. Co.	32616-H4
S-2	88056	SWITCH, Rotary, 2 pole, 3 position, 1 section	Centralab	2TX8686
S-3	88083	SWITCH, Rotary, 2 pole, 3 position, 1 section	Centralab	2TX8686

Reference Symbol	Boonraco No.	Description	Manufacturer	Manufacturer's Designation
S-4	88060	SWITCH, Rotary, 2 pole, 2 position, 1 section	Centralab	2TX8685
S-6	88059	SWITCH, Toggle, DPDT	Arrow-Hart and Hageman Electric Co.	82305B
V-1		TUBE, 6AU6		
V-2		TUBE, 6V6		
V-3		TUBE, 5Y3		
V-4		TUBE, OD3/VR-150		
X-1,2	91018	CRYSTAL UNIT, Recifying, germanium diode	Sylvania Elec. Prod.,Inc.	1N34
	20205	RF UNIT, Complete	Boonton Radio Corp.	20205
	85074	TRANSFORMER, Power, filament and plate	Freed Transformer Co.,Inc.	13643
	89022	LIGHT, Indicator, miniature bayonet	Dial Light Co.	BV-844S
	89026	LAMPHOLDER, candelabra base	Bryant Electric Co.	328
	89047	SOCKET, Tube, octal (5 req'd)	Ucinite	115001-1A
	89065	CONNECTOR, Receptacle, one round female contact	Industrial Products Co.	UG-291/U
	89067	SOCKET, Tube, 11 contact	Amercian Phenolic Corp.	MIP-11
	89074	SOCKET, Tube, 7 contact, miniature	Eby Sales Co.	8083

Reference Symbol	Boonraco No.	Description	Manufacturer	Manufacturer's Designation
	89076	CONNECTOR, Receptacle, two female contacts	Arrow-Hart and Hageman Electric Co.	295
	89102	CONNECTOR, Receptacle, recessed, two male contacts	General Electric Co.	2711
	93251	FUSE, 2a	Littlefuse, Inc.	3AG-2
	93677	HOLDER, Fuse, extractor post	Bussmann Mfg. Co.	HKP
	94148	CONNECTOR, Plug, eight round male contacts	American Phenolic Corp.	PM-8-11
	94149	CONNECTOR, Plug, eleven round male contacts	American Phenolic Corp.	PM-11-11
	300729	CORD, Power, separable	Boonton Radio Corp.	300729